PATENT SPECIFICATION

665,652

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COMPLETE SPECIFICATION

Improvements relating to the Grinding of Rotary Cutters

We, ROBERT LEGG LIMITED, a British Company, of City Engine Works, Eagle Wharf Road, London, N.1, and PATRICK QUINTIN ROBERT SCHREIBER, a British Subject, of the Company's address, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the sharpening by grinding of rotary cutters of the type having one or more cutting knife edges which can be defined geometrically as lying in a cylindrical surface whose axis is the axis of rotation of the cutter. In many such cutters the cutting edges are parallel to the axis, but they may lie on helices or on any other lines lying in the cylindrical surface. These cutters may be ground by rotating them in contact with the rim of a disc wheel or the face of a cup wheel, either wheel being rotated on an axis in the same plane as that of the cutter. The possible points of contact between the wheel and the cutting edges lie on a single line in the plane of the axes. Thus for much of the time as the cutter is turned no grinding at all is taking place, and the cutter and wheel are subject to intermittent shocks of contact and separation.

According to the present invention a rotary cutter having one or more cutting edges lying in a cylindrical surface is ground by engagement with the rim of a disc wheel turning in a plane slightly inclined, say at 5°, to the axis of the cylinder. The rim of the wheel is hollowed to match the cylinder so that the possible points of contact between the wheel and the cutting edges lie on an arc of a fine-pitch helix in the cylinder. The length of this arc depends upon the thickness, that is to say the axial length of the wheel. The length of each cutting edge parallel to the axis of the cutter over which contact may occur depends on the angle of inclination and the thickness of the grinding wheel. In general, this is only a small fraction of the total length of each cutting edge and accordingly the wheel is moved parallel to the axis of the cutter during operation.

This invention is particularly applicable to machines of the rotary drum type used for cutting leaf tobacco. In these machines the cutter is formed by a drum having a considerable number of knives parallel to the axis and equally spaced round the circumference of the drum. These machines present the advantage that if the knives are closely spaced around the circumference of the drum the cutting is practically continuous and so the output of cut tobacco is high. In order to make this output as high as possible the knives must be kept constantly sharp by grinding them while the machine is working. At the same time the knives must move as fast as possible, consistent with good cutting, for the same reason. Accordingly the problem that arises in making such a machine is to ensure that it will remove some metal from the cutting edges of the knives, without distorting or overheating them and without producing rapid wear of the grinding wheel, in an extremely limited time. If the grinding action has to take place too quickly both the cutting edges and the wheel suffer. By means of the present invention the time during which each cutting edge is actually being ground is greater than when a cylindrical or cup grinding wheel is used with the drum rotating at the same speed.

The grinding wheel used according to the invention in combination with a drum cutter of the kind described above may be of such thickness that at all times there will be at least one knife in contact with the wheel. Thus grinding will occur continuously. In order to grind the full length of the cutting edges, the wheel is preferably reciprocated continu-

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ously in a direction parallel to the axis of the drum.

The contour of the hollowed rim of the wheel may be maintained by dressing with a diamond which swings about an axis in the plane of turning of the grinding wheel at a radius slightly greater than that of the cutting edges from the axis of the drum. This dressing produces a contour which is satisfactory in practice, although in theory the section of the surface of the rim should be part of an ellipse.

An example of an apparatus according to the present invention is shown in the accompanying drawings in which:—

Figure 1 is an elevation of one side of a complete machine;

Figure 2 is an elevation on a larger scale of part of the other side of the machine;

Figure 3 is a view of the machine in section on the line III—III in Figure 2;

Figure 4 is an exploded perspective view on a still larger scale of the grinding device;

Figure 5 is a view of the grinding device looking from one end of the machine, the device being in section on a plane containing the axis of the grinding wheel; and

Figure 6 is a view of the grinding device in section on the line VI—VI in Figure 5.

Leaf tobacco is fed into the space 2 between two converging conveyor belts 4 and 6 which carry the tobacco to a mouthpiece 8 and at the same time compress it so that it is driven through the mouthpiece as a plug. As the plug emerges it is shredded by knives 10 on a drum 12 which is turned on a shaft 13 by a drive 14. The cutting edges of the knives all lie in an imaginary cylindrical surface which is indicated at 16 and they are very slightly inclined to lines parallel to the axis of the drum so that they engage the tobacco progressively at each cut. The cut tobacco is carried clear of the drum by an air blast set up in ducts 18 and 20 by a fan 22 and is then removed by conveyors 24 and 26.

The shaft 13 carrying the drum is carried in bearings 30 at the ends of arms 32. These arms are each pivoted at 34 to the base of the machine and together form a support both for the drum and for a bed 36 on which slides a carriage 38 forming the bottom of a grinding device 40. The support can rock to and from the mouthpiece under the control of a linkage operated by a handwheel 42. This linkage includes a shaft 44 which carries on each end a crank 46. The cranks are each connected to an arm 32 by a pivoted link 48, and are arranged so that the small movement of the drum necessary to adjust the clearance between the cutting edges and the mouthpiece is brought about by movement of the cranks through an arc slightly to one side of a dead centre position. The shaft 44 is turned by the handwheel 42 through a worm drive 50 and bevel gears 52. Movement of the cranks in the direction to reduce the clearance is limited by a stop 54.

If it is desired to inspect the mouthpiece 8, the shaft 44 can be turned to move the crank 46 into a position 56 in which the arms 32 are rocked the full distance permitted by the throw of the cranks.

The grinding device 40 incorporates a disc grinding wheel 58 mounted to turn on a shaft 60 in a housing 62. The inclination of the shaft 60 is shown in Figure 5, and the hollowing of the rim of the wheel 58 to match the cylinder 16 is shown at 64 in Figure 6. This wheel 58 is caused to sharpen the full length of the cutting edges of the knives 10 by reciprocation of the carriage 38 on the bed 36. The speed of travel of the carriage should be such that in each revolution of the drum 12 the carriage moves a distance rather less than the projection on the axis of the drum 12 of the helical arc of engagement between the rim of the wheel 58 and the cylinder 16.

As the cutting edges of the knives 10 are continuously sharpened, metal is worn away from them, and at the same time the rim of the wheel 58 is also worn away. Arrangements are made to compensate for this wear and so maintain a constant diameter of the cylinder 16. The knives 10 are progressively fed outwards on the drum 12 by mechanism indicated generally at 66. A particular mechanism for carrying out this feeding is described and claimed in my copending application No. 9291/49 (Serial No. 665,653). This mechanism operates to move the knives outwards a small distance each time the carriage 38 reaches the end of a stroke and the wheel 58 is just clear of the cutter.

The housing 62 and with it the wheel 58 is movable on the carriage 38 and is gradually fed towards the drum 12. At the same time the contour 64 of the rim of the wheel 58 is maintained by dressing with a diamond 68. This diamond is at the end of an arm 69 which can swing about an axis 70, the radius of the diamond from that axis being slightly greater than that of the cylinder 16. The arm 69 is caused to swing up and down

at each reciprocation of the carriage 38 by means of a fixed cam 72, a follower 74, and a push rod 76. Thus the full thickness of the rim of the wheel is dressed. Moreover the arm 69 is carried on a slide 78 movable on an extension 80 of the housing 62. The movement of the slide 78 is controlled by the engagement of a pin 82 in a slot 84 in a block 86 on the carriage 38. This slot 84 is inclined at 45° to the line of travel of the housing 62 and thus as the wheel 58 is moved towards the drum 12 by a certain amount so the diamond is moved towards the wheel by the same amount. As a result the wheel 58 gradually decreases in diameter but maintains a constant diameter of the cylinder 16, as the cutting edges of the knives 10 are progressively fed outwards and ground away.

What we claim is:—

1. Apparatus, for sharpening a rotary cutter having one or more cutting edges lying in a cylindrical surface of given diameter, comprising a disc grinding wheel which is mounted to turn in a plane inclined at a small angle to the axis of the cutter and which has its rim hollowed slightly to match the curvature of the given cylinder and so engages the cutter over a helical arc on the cylinder determined by the thickness of the rim of the wheel.

2. Apparatus, for cutting leaf tobacco or the like comprising a rotary cutter having several cutting edges lying in a cylindrical surface, and a disc grinding wheel for sharpening the cutter while in use, which is mounted to turn in a plane inclined at a small angle to the axis of the cutter and which has its rim hollowed slightly to match the curvature of the cylinder and so be capable of engaging the cutter over a helical arc on the cylinder determined by the thickness of the rim of the wheel.

3. Apparatus according to claim 2 in which the grinding wheel is reciprocated continuously in the direction of the axis of the cutter with a stroke sufficient to sharpen the cutting edges over their full length.

4. Apparatus according to any of claims 1 to 3 in which the grinding wheel is mounted in a carrier movable parallel to the axis of the cutter at a speed such that at each revolution of the cutter the carrier moves a distance slightly less than the projection of the arc of engagement on the axis of the cutter.

5. Apparatus according to any of claims 1 to 4 in which a diamond is mounted to dress the hollow rim of the wheel by swinging about an axis in the plane of turning of the grinding wheel at a radius from that axis slightly greater than that of the cutting edges from the axis of the cutter.

6. Apparatus according to claim 5 in which movement of the grinding wheel along the full length of the cutting edges causes movement of the diamond across the full thickness of the wheel.

7. Apparatus according to claim 5 or claim 6 in which movement of the grinding wheel towards the axis of the cutter causes equal movement of the diamond towards the axis of the wheel so that the wheel is dressed to maintain a constant diameter on the cutter.

8. A method of sharpening rotary cutters having one or more cutting edges lying in a cylindrical surface in which the edges are engaged by the rim of a disc grinding wheel turning in a plane inclined at a small angle to the axis of the cutter, the rim being hollowed to match the curvature of the cylinder.

9. A method according to claim 8 in which the grinding wheel is reciprocated continuously parallel to the axis of the cutter.

10. A method according to claim 8 or claim 9 in which the grinding wheel is dressed by a diamond while in engagement with the cutter.

11. A method according to claim 10 in which the grinding wheel is fed towards the cutter and the diamond is fed towards the wheel at the same rate so that the cutter is sharpened to a constant diameter.

12. A method according to any of claims 8 to 11 in which the blades of the cutter are fed outwards during the grinding operation.

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PROVISIONAL SPECIFICATION

Improvements relating to the Grinding of Rotary Cutters

We, ROBERT LEGG LIMITED, a British Company, of City Engine Works, Eagle Wharf Road, London, N.1, and PATRICK QUINTIN ROBERT SCHREIBER, a British Subject, of the Company's address, do hereby declare the nature of this invention to be as follows:—

This invention relates to the sharpen-

ing by grinding of rotary cutters of the type having one or more cutting knife edges which can be defined geometrically as lying in a cylinder whose axis is the axis of rotation of the cutter. In many such cutters the cutting edges are parallel to the axis, but they may lie on helices or on any other lines lying in the cylinder. These cutters may be ground by rotating them in contact with the rim of a disc wheel or the face of a cup wheel rotated on an axis in the same plane as that of the cutter. The possible points of contact between the wheel and the knives lie on a single line parallel to and in the plane of the axes. Thus for much of the time as the cutter is turned no grinding at all is taking place, and the cutter and wheel are subject to intermittent shocks of contact and separation.

According to the present invention a rotary cutter with knife edges lying in a cylinder is ground by a wheel turning in a plane slightly inclined, say at 5°, to the axis of the cylinder. The rim of the wheel is hollowed to match the cylinder so that the possible points of contact between the wheel and the knives lie on an arc of a fine-pitch helix in the cylinder. The length of this arc depends upon the thickness or axial length of the wheel. The length of each knife edge parallel to the axis of the cutter over which contact may occur depends on the angle of inclination and the axial length of the grinding wheel. In general, this is only a small fraction of the total length of each knife edge and accordingly the wheel is moved parallel to the axis of the cutter during operation.

This invention is particularly applicable to tobacco cutting machines of the rotary drum type. In these machines the cutter is formed by a drum having a considerable number of knives parallel to the axis and equally spaced round the circumference of the drum. These machines present the advantage that if the knives are closely spaced around the circumference of the drum the cutting is practically continuous and so the output of cut tobacco is high. In order to make this output as high as possible the knives must be kept constantly sharp by grinding them while the machine is working. At the same time the knives must move as fast as possible, consistent with good cutting, for the same reason. Accordingly the problem that arises in making such a machine is to ensure that it will remove some metal from the knife edges, without distorting or overheating them, and without producing rapid wear of the grinding wheel, in an extremely limited time. If the grinding action has to take place too quickly both each knife edge and the wheel suffer. By means of the present invention the time during which each knife edge is actually being ground is greater than when a cylindrical or cup grinding wheel is used with the drum rotating at the same speed.

The grinding wheel used according to the invention in combination with a cutter drum of the kind described above may be of such thickness that at all times there will be at least one knife in contact with the wheel. Thus grinding will occur continuously. In tobacco cutting machines of the rotary drum type the knives are generally so long that the grinding wheel cannot extend completely across them from one end of the cutting edge to the other and accordingly the wheel is made to traverse the drum as the latter is turned. Preferably the speed of movement of the wheel in a direction parallel to the axis of the drum is such that in one revolution of the drum it moves through a distance somewhat less than the projection of the helical arc upon a line parallel to the axis of the drum.

While precise theory requires the section of the hollow rim of the wheel to be elliptical if contact is to be made between the knife edge and the wheel throughout the whole of the helical arc, it is found in practice that a suitable profile can be obtained by dressing the wheel with a diamond swung in a circular arc of radius slightly greater than that of the cylinder in which the knives of the cutter lie. In a rotary tobacco cutting machine means may be provided for feeding this diamond inwardly towards the wheel so as to compensate automatically for wear as the cutting and grinding proceed.

Dated this 5th day of April, 1949.

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51/2, Chancery Lane, London, W.C.2.

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FIG.1.

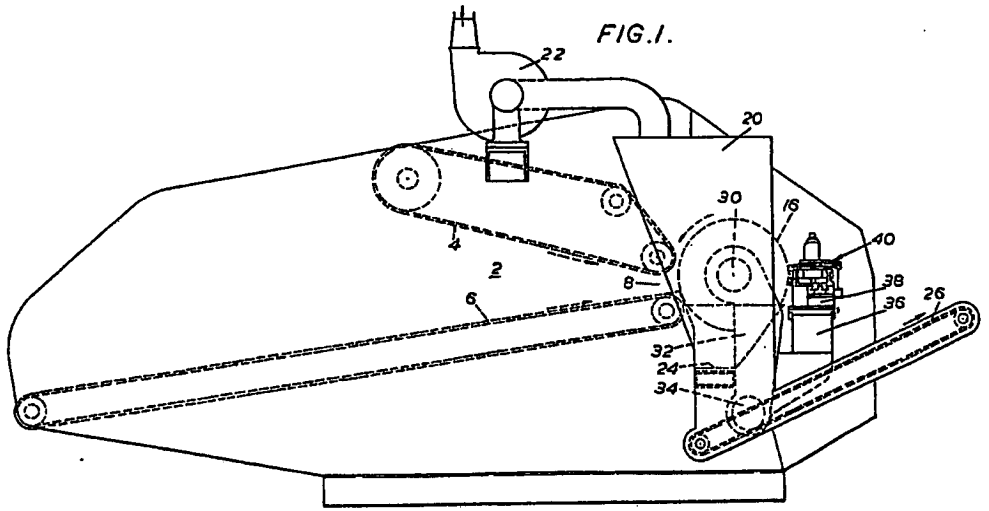

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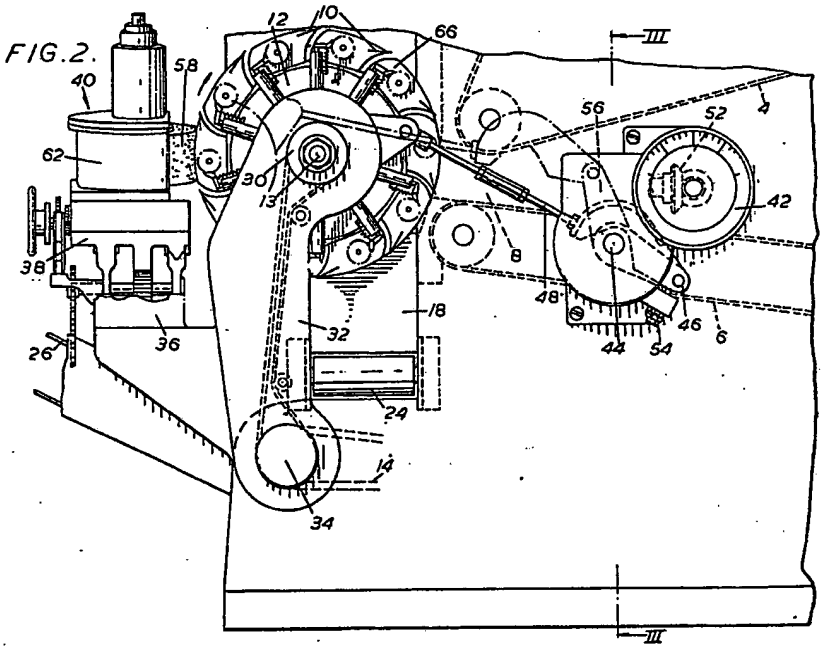
FIG. 2.



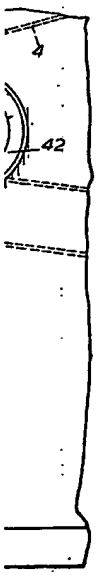


FIG. 3.

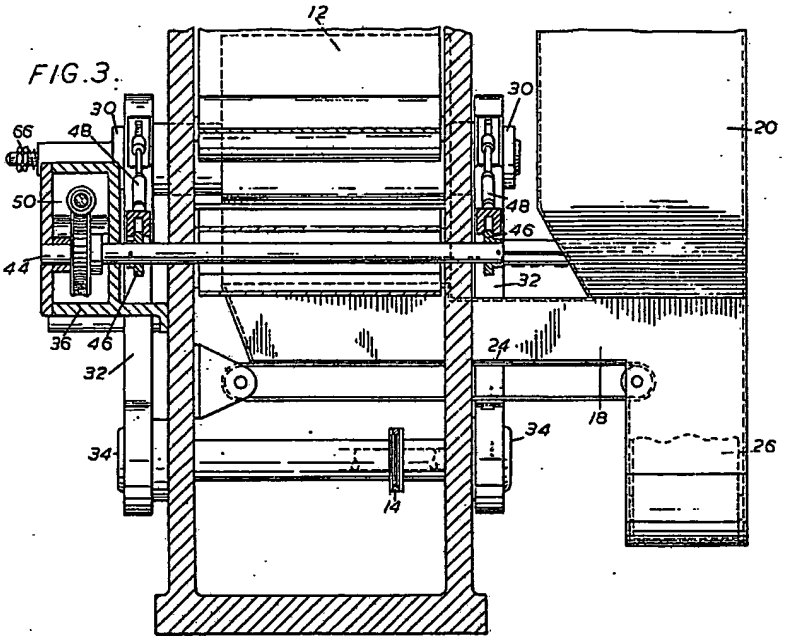


FIG. 4.

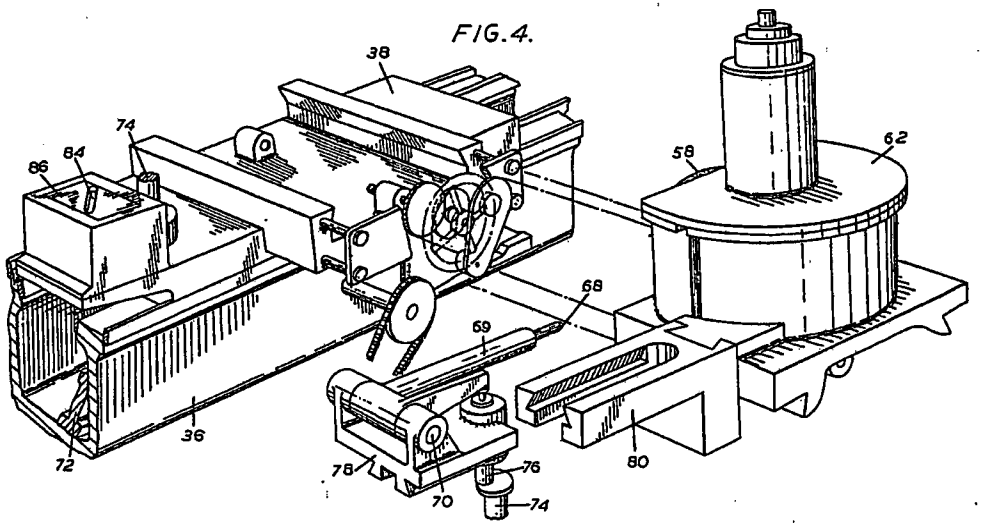


FIG.6.

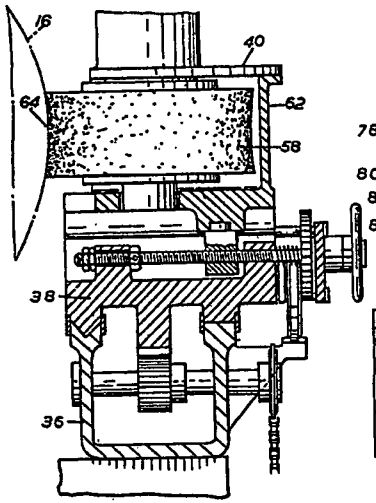
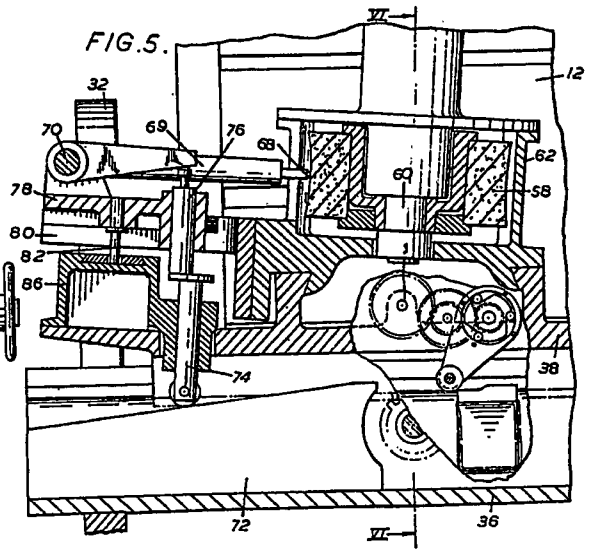


FIG.5.



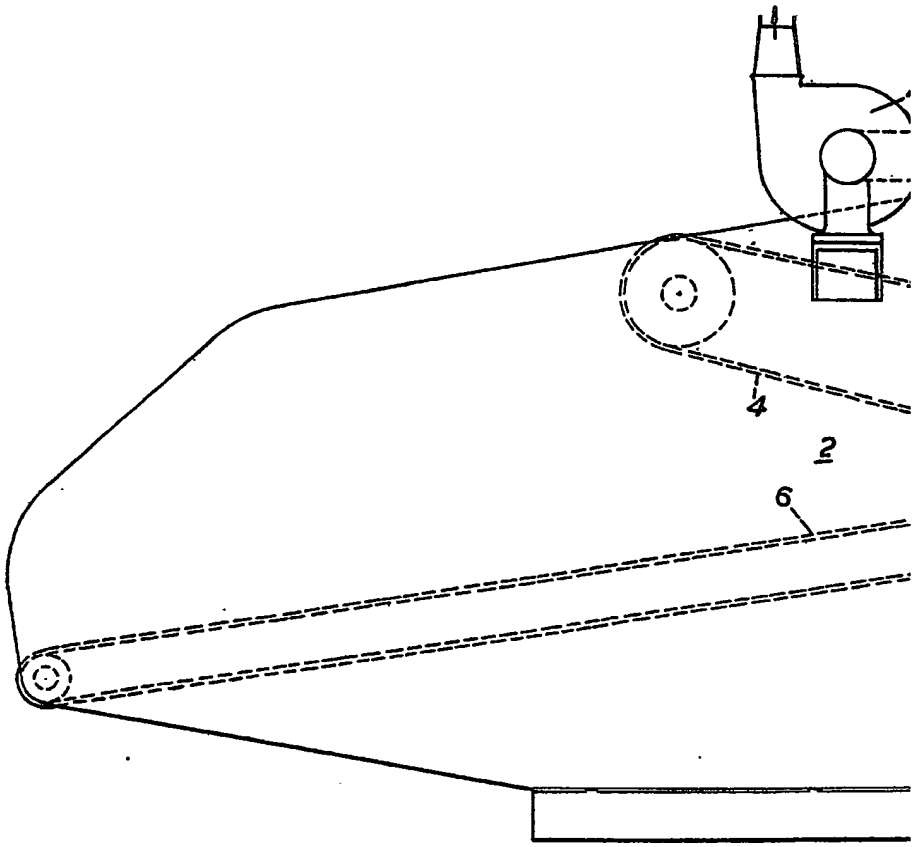


FIG. 1.

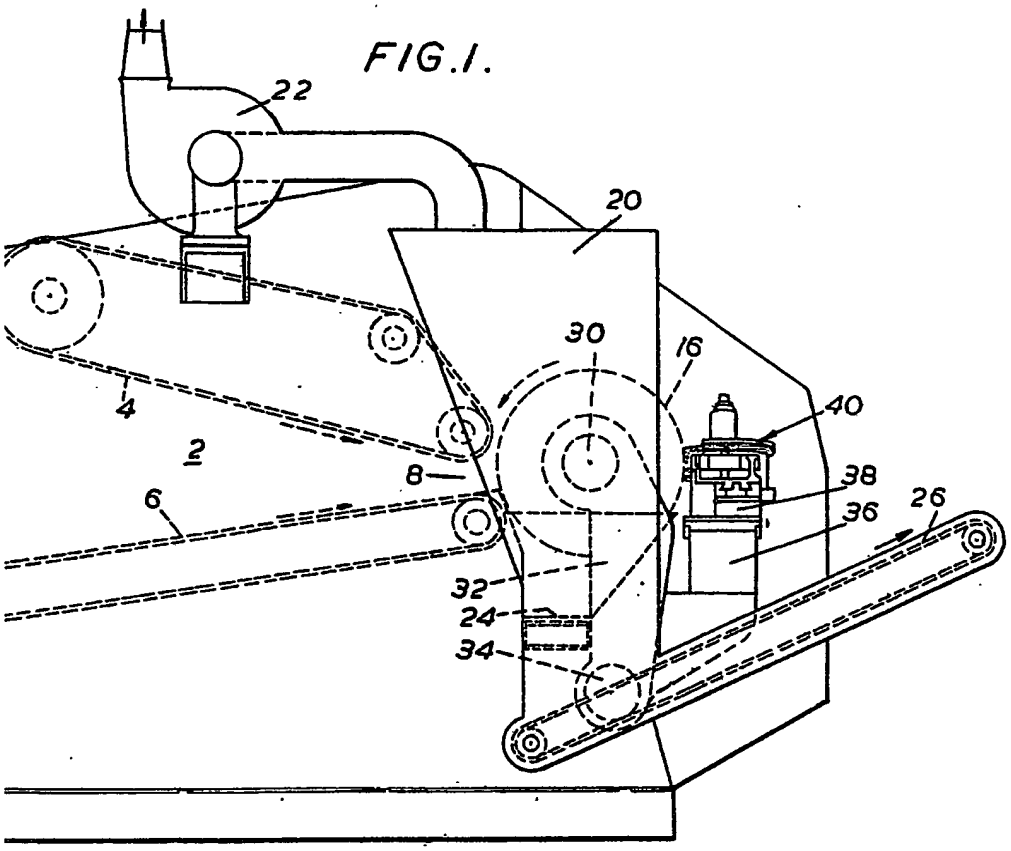


FIG. 4.

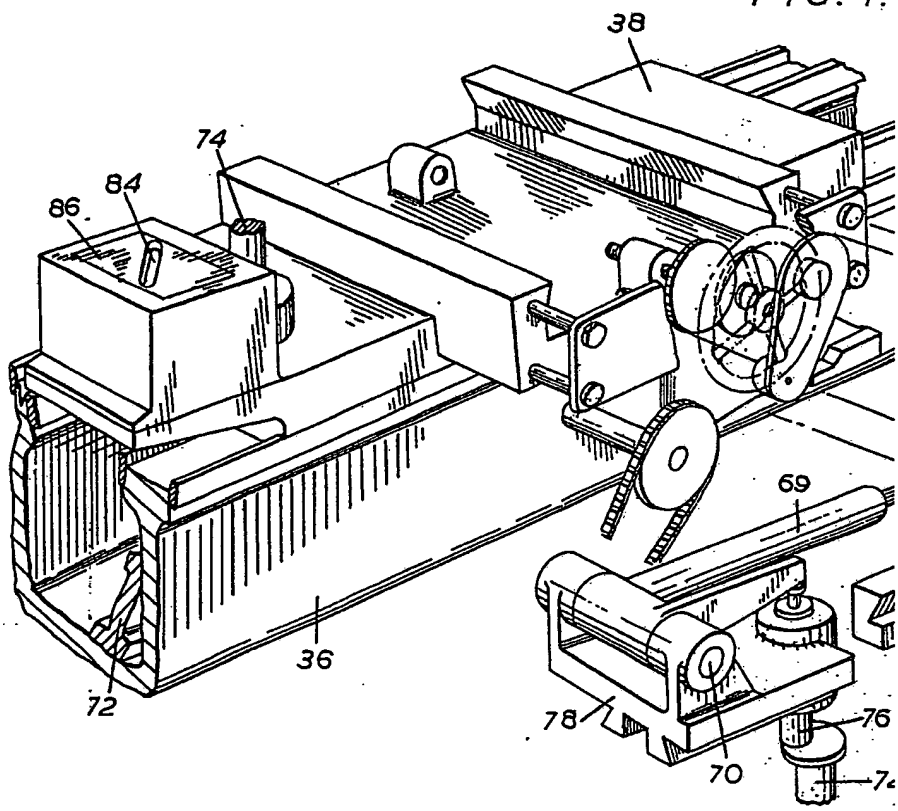


FIG. 4.

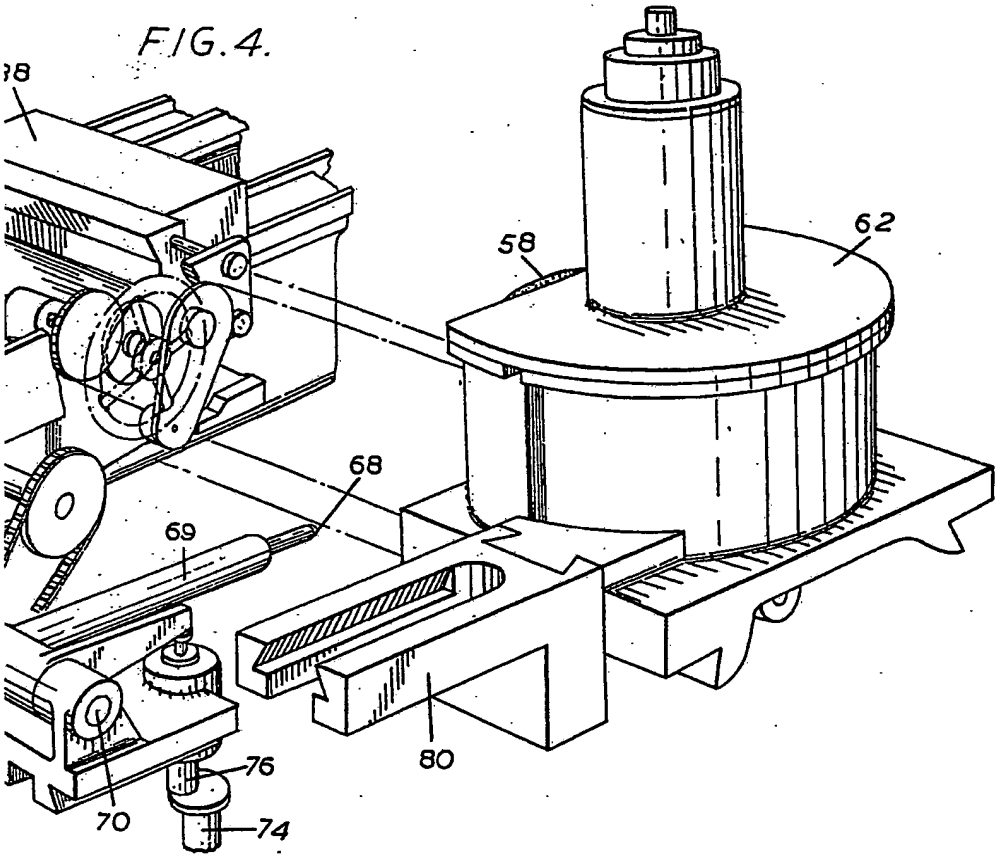


FIG.6.

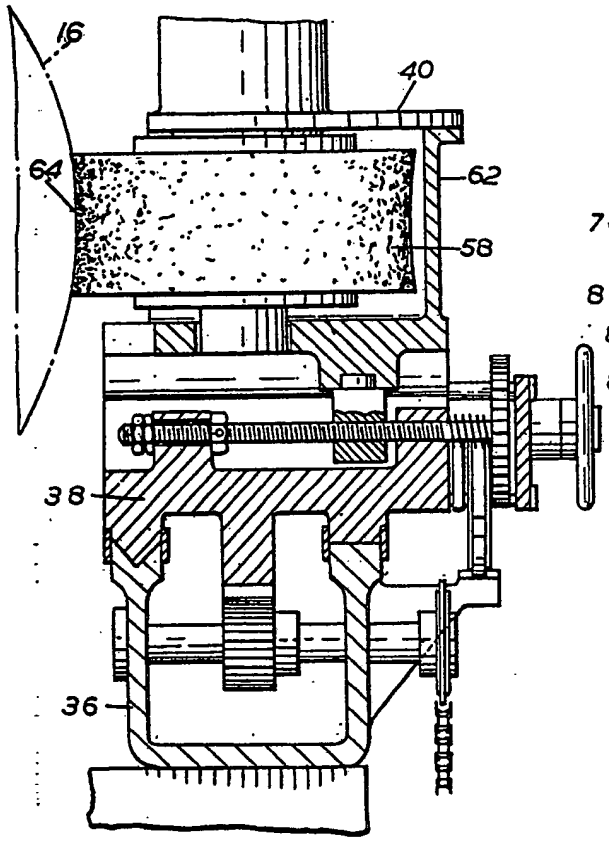


FIG.5

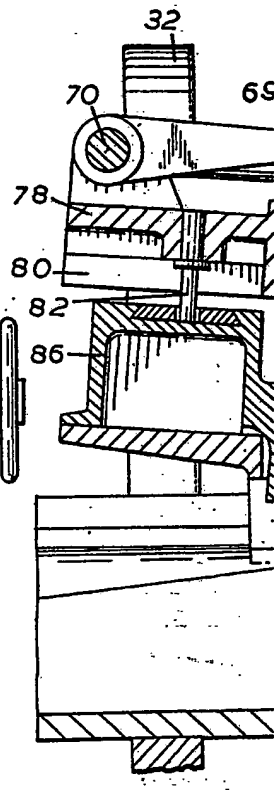
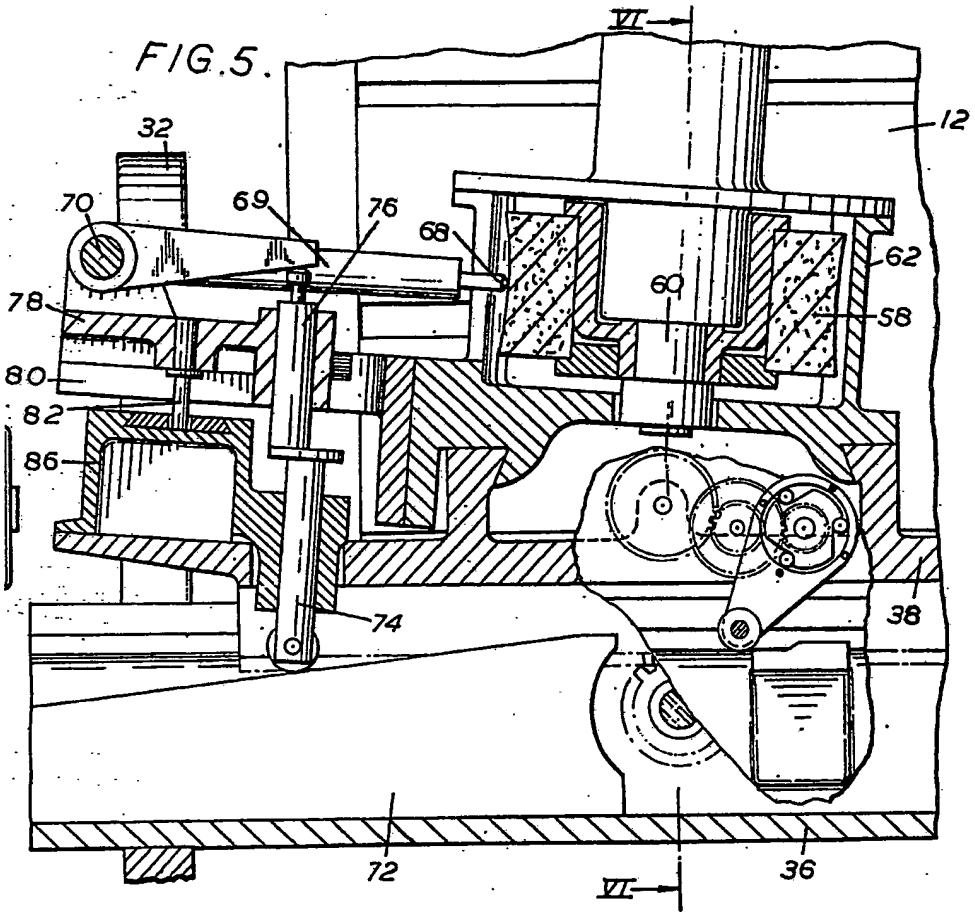


FIG. 5.



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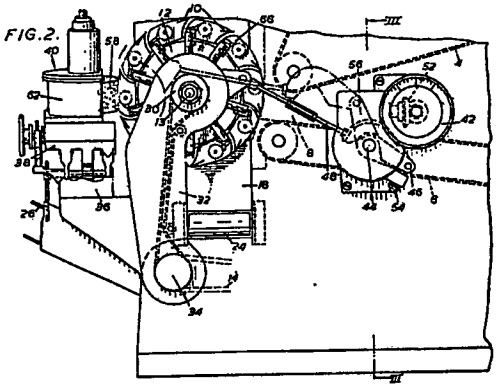
5 SHEETS

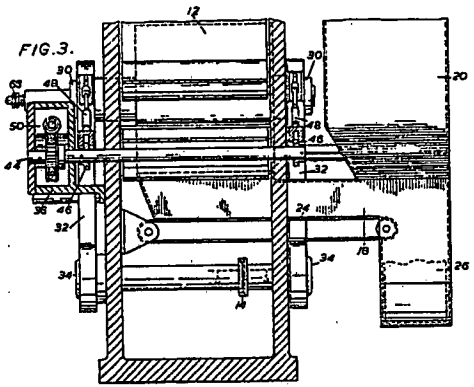
SHEET 2

FIG.2.



SHEET 3

FIG.3.



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